Vortex States in a Spin-Triplet Pairing Superconductor

M. Ichioka, H. Adachi, T. Mizushima, and K. Machida

Department of Physics, Okayama University, Okayama 700-8530, Japan.

We discuss two topics related to a chiral p-wave superconductor with spin-triplet pairing.
(1) By simulation study of time-dependent Ginzburg-Landau (TDGL) equations, we investigate vortex and domain structures in a two-component chiral p-wave superconductor[1], as a model of superconductivity in Sr_2RuO_4. We discuss the difference of vortex structure in the p_+state domain and the p_- state domain, where other chiral component is induced around the vortex. Related to this difference, in the magnetization process when applied fields are increased from a zero field, we see how the multi-domain structure with p_+ and p_- domains at a zero field is changed to a single p_-domain by applying magnetic field. We also discuss roles of domain walls in the magnetization process, and exotic vortex structure at the domain wall called "vortex sheet", which consists of coreless vortices with half flux-quantum.
(2) The Pauli paramagnetic effect suppresses the superconductivity at higher magnetic fields in the spin singlet pairing or in the triplet pairing when the ***d***-vector is parallel to the magnetic field. Based on the quasiclassical Eilenberger theory, we estimate the contribution of the paramagnetic effects on the vortex states, such as the spatial structures of the order parameter, paramagnetic moment, internal magnetic field distributions and local electronic structures. We also calculate the field-dependence of the zero-energy density of states (low temperature specific heat), magnetization, and paramagnetic spin susceptibility in the presence of the paramagnetic depairing effects.

[1] M. Ichioka, Y. Matsunaga, and K. Machida, Phys. Rev. B **71**, 172510 (2005)